MELTING OF PINNED WIGNER SOLID IN HIGH MAGNETIC FIELD

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In their low Landau filling (ν), pinned Wigner crystal phase, two-dimensional electron systems (2DES) exhibit a striking microwave or rf resonance due to a pinning mode in which pieces of the crystal oscillate about their pinned positions. We measured the temperature above which the pinning mode disappears to estimate the melting temperature (T_m) of the pinned crystal, in several samples whose density (n) was controllable by means of a backgate. For each sample, T_m data for separately varied n and magnetic field B appear as a single curve when plotted against ν. The figure shows T_m vs. ν for n varying over a factor of 6.7. Since $\nu = nh/eB$, such plots imply $T_m(n,B) = T_m(n/B)$. This result indicates that the classical limit, in which T_m depends only on n, is not accessed, and that rescaling the classical melting temperature by a ν-dependent factor is likewise not a good description of the data. Instead, the quantum correlations among the electrons, as measured by ν, which goes as $(l_B/r)^2$, where l_B is the size of the single-electron wave function and r is the electron spacing, must play a dominant role in the melting. Comparison between samples shows, as well, that disorder is important in stabilizing the pinned crystal with temperature, since T_m is larger for samples of larger disorder.

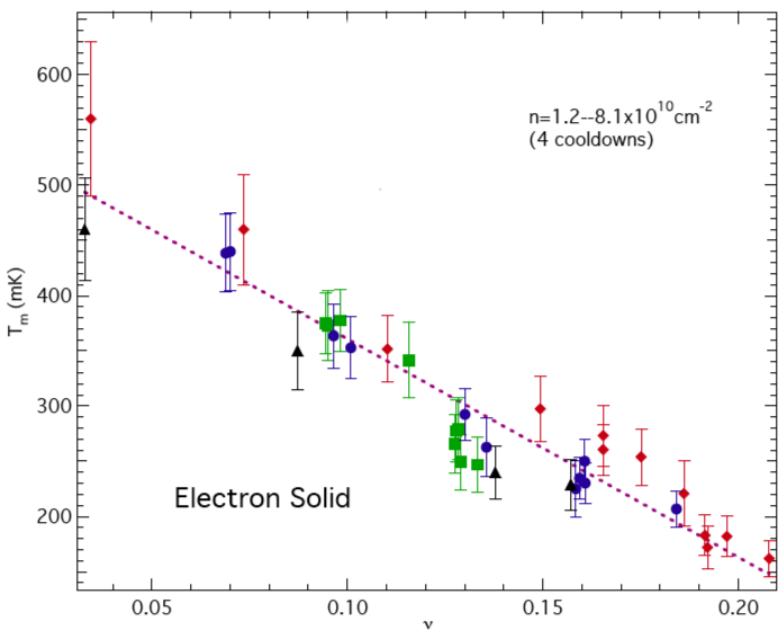

Fig. 1. Melting temperature T_m vs. Landau filling ν for a heterojunction sample, with density n varied from 1.2 to 8×10^{10} cm^{-2}. Different symbols correspond to different cooldowns. This can be regarded as a phase diagram, with the electron solid range below the curve and the liquid phase above it. The data for all densities and many magnetic fields form a single curve, and the dotted line is a guide to the eye.

Acknowledgements

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References

[1] See, for example, Ye, P.D., *et al*., Phys. Rev. Lett., **89**, 176802 (2002).
[2] Chen, Y.P., *et al*., submitted to Nature.